Research Problem Review 77-10

LEVEL II

SUITABILITY EVALUATION OF THE FORT BENNING NOE TRAINER

ARI FIELD UNIT AT FORT RUCKER

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Aircrew Performance

Research Problem Review-77-10

SUITABILITY EVALUATION OF THE FORT BENNING NOE TRAINER

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FOREWORD

The Fort Rucker Field Unit of the Army Research Institute provides timely support to the US Army Aviation Center (USAAVNC) through research and development efforts to enhance aircrew performance in the tactical environment. Because the Army aviator must perform his mission successfully with maximum survivability within a high threat environment, the ARI program of research and development addresses, in some detail, every stage of the aviator's development.

The research described in this report was conducted in response to a request from the Deputy for Training Developments, USAAVNC. That request identified a relatively "short-fuse" requirement to assist in the evaluation of a prototype nap-of-the-earth (NOE) navigation trainer for use as a locally fabricated device designed to assist in teaching NOE navigation techniques in the unit training environment. The report outlines the recommended evaluation methodology and data analysis. Recommendations were made as a result of the evaluation.

Research in this area was conducted, in-house, as a part of RDTE Project 2Q763743A772, Aircrew Performance in the Tactical Environment. It exemplifies the type of early response often required by operating agencies who need a basis for operating or research decisions.

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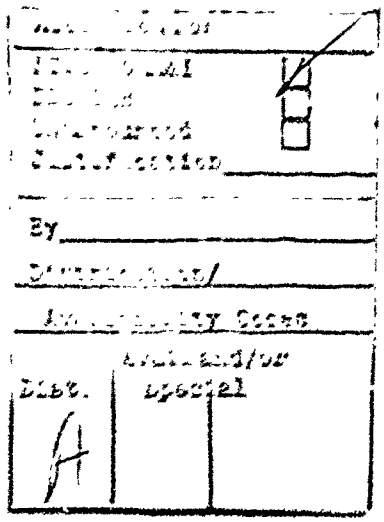

SUITABILITY EVALUATION OF THE FORT BENNING NOE TRAINER

BRIEF

Requirement:

At the request of the Director of Training Developments of the US Army Aviation Center (USAAVNC), to evaluate a prototype nap-of-earth (NOE) training device developed at Fort Benning for possible use at USAAVNC, Fort Rucker.

Procedure:

At Fort Rucker, 44 NOE-qualified instructor pilots tried the device and evaluated its potential training effectiveness along a 24-item, 8-point scale. The scale covered the essential areas of pilot/copilot familiarization, preflight navigation, realism, minimizing flying hours, terrain interpretation, and intercrew coordination.

Findings:

Pooled ratings from the instructor pilots indicated that developing the possibilities of the device would not be cost-effective, in view of existing devices at Fort Rucker.

Utilization of Findings:

The Director of Training Developments concurred with the recommendations and no further action was taken on the Fort Benning NOE trainer.

SUITABILITY EVALUATION OF THE FORT BENNING NOE TRAINER

INTRODUCTION

In March 1976 the Aviation Center was informed that the Director of Educational Technology at the US Army Infantry School had developed a prototype NOE navigation trainer for use as a locally fabricated Training Aids Service Office (TASO) device to assist in teaching NOE navigation techniques in the unit training environment. It was stated that development had proceeded to the point that additional efforts were required (1) to subject the device to proponent assessment on its applicability for NOE training, and (2) to validate the degree of simulation fidelity afforded by that prototype design. (The prototype device had been shipped previously to TASO, Ft. Rucker.) It was requested that the Army Aviation Center evaluate this prototype device and make any modifications necessary to permit its use as a low-cost simulator for training at the unit level.

The history of this device antedates the 1976 message. In fact, an active project was underway during September and October 1974 to evaluate the trainer. However, the project was terminated because Ft. Benning personnel could not overcome technical problems in device design. The Director of Training Developments (DTD) advised the Commanding General of the US Army Aviation Center that the Ft. Benning NOE trainer would require an extensive rebuild effort before it would be ready for re-evaluation. The Commanding General was further advised that it was doubtful whether the trainer could be made useful within the pre-established dollar constraints ($3,000) for design and construction. The DTD suggested that a USAAVNC device offered more potential for evaluation than did the Ft. Benning trainer. It was recommended that the Ft. Benning NOE trainer evaluation be held in abeyance pending further guidance from TRADOC and a visit by an interested officer.

The Commanding General's reply to the DTD required that the Aviation Center accomplish what it was asked to do, i.e., to evaluate the NOE trainer as it existed, listing its strengths and deficiencies. The Commanding General directed that this device not be compared with the Ft. Rucker trainer during the evaluation, but be evaluated on its own merits. Then the DTD was to point out the USAAVNC's abilities to accomplish what the Benning trainer was designed to do. The Commanding General's opinion was that a great amount of money had been spent in the Benning project over the years and that it should show some capability immediately or be terminated in favor of better approaches.

When the first evaluation was to take place in the 1973-74 period, ARI, then in Arlington, drafted a preliminary test plan for evaluation of the training effectiveness of the navigation trainer. This test plan called for a transfer experiment in which experimental and control groups would be trained using films and trained in aircraft, and then differences in performance would be assessed. However, it was not feasible to conduct an evaluation according to this preliminary draft because the NOE trainer, as it was then configured at Ft. Rucker, was in the words of the DTD, "in need of extensive rebuild effort" before it would be

ready for evaluation. Ensuing conversation between ARI, Ft. Rucker, and the DTD led to the request that a test plan for evaluation of the training effectiveness of the Ft. Benning NOE trainer be developed by ARI, Ft. Rucker. The guidelines were that an opinion-type survey designed to address six specific areas would be suitable. These six areas were designated Essential Elements of Analysis, which express the DTD conceptualization of the claims which the NOE Trainer designer set forth for the device. Thus, ARI, Ft. Rucker was requested to evaluate the device's effectiveness and determine whether it had the potential to achieve the advertised claims.

The device's designer claimed that the device could:

1. Familiarize the pilot and copilot with procedures and techniques of NOE flight.

2. Permit the crew to navigate a course before actual flight.

3. Maintain realism, to a point of near vertigo, through use of control panels and sound effects.

4. Minimize actual flying hours.

5. Require the employment of terrain interpretation.

6. Teach the crew to maintain intercrew coordination.

Finally it was requested that ARI provide comments on the suitability of the Ft. Benning NOE trainer, or another low-cost device presently available, as an exportable NOE training medium.

With the above information as background, this research problem review outlines the procedures used in responding to the request from the Director of Training Developments, US Army Aviation Center.

METHOD

APPROACH

It was recommended that the evaluation be conducted in successive stages so that the first stage would serve to determine whether the second stage was required, and the second stage would determine whether the third stage was required.

Stage I - Operational Capability. The purpose of this stage was to determine the operational capability of the device. It was recommended that a representative from Training Aids Service Office (TASO) and a representative from Department of Academic Training (DOAT) perform a thorough examination of the device to consider its mechanical operational capability. The team from TASO and DOAT would determine whether all mechanical features designed into the device were operating as specified

and, if not, the team would determine the requirements necessary to make the device functional. This step was to include a determination of whether the device had been completely assembled and whether the assembly had been satisfactory. The expected output of this stage was a statement either that the device was capable of performing as advertised or of whether it would be cost beneficial to make the device operational.

It was also recommended that, after the above stage had been completed, DOAT draft a training program, or guide, outlining anticipated uses for the device. This would include, but would not be limited to, addressing the essential elements of analysis listed in the introduction. The training guide would also be basis for subsequent evaluations and, therefore, should be written to indicate its use as a course of instruction. This step was deemed necessary because the device was advertised to accomplish more than map interpretation, terrain analysis and other associated NOE navigation-related instructions.

It was planned that the second stage of the evaluation would be accomplished if the team judged the device to be in suitable condition.

Stage II - Operational Suitability. The purpose of this stage was to rate the device's suitability for accomplishing the seven essential elements of analysis listed in the introduction, and to rank these seven items as to their appropriateness as design criteria. This stage was designed to be conducted by NOE-qualified instructor pilots (IPs) from the Department of Undergraduate Flight Training (DUFT).

The expected outcome of this stage was a rating scale and a ranking scale which could answer the question of whether it was necessary to continue the evaluation to include a formal transfer of training study (Stage III). If a formal transfer of training study proved to be required, Stage III was to have been implemented.

DEVICE DESCRIPTION INVENTORY

A Device Description Inventory, attached as Appendix A, was constructed for use by IPs to determine the device's suitability for the training outlined in the seven essential elements of analysis. The Inventory was designed to elicit the opinions of the experienced NOE instructor pilots and provide for both ratings and rankings, and in addition, to provide the opportunity for written comments.

Items or stems were developed after interviewing several instructor pilots to determine the requirements of NOE training. This ensured accuracy of the items stating the requirements for NOE navigation, etc.

It is possible this device was "over designed" to the extent that its inventor envisioned one or more roles as necessary or useful to the defined task though that role actually was not necessary. Thus, the

opportunity for ranking the importance of the elements was also provided. Therefore, the ranking procedure served to determine whether the favorable points of the device were also necessary and sufficient for NOE training.

Twenty-four items were pooled for the final form of the Inventory. Each item was designed to cover at least one of the essential elements. Table 1 lists the essential elements and indicates the items which apply to each element.

Table 1

ESSENTIAL ELEMENTS OF ANALYSIS AND ASSOCIATED ITEMS

Element	Item
Familiarize pilot and copilot with procedures and techniques of NOE	1-8
Navigation of a proposed course before actual flight	10
Realism to a point of near-vertigo	20-21
Realism through the use of control panels and sound effects	22-24
Minimize actual flying hours	9,13,14,16,18
Terrain interpretation	11,12
Intererew coordination	15,17,18

The Inventory rating scale was composed of statements concerning the capability of some aspect of the device, and subjects were to indicate how well a statement described or "fit" what the subject experienced in the device. A rating of 1 or 2, based on the subject's experience, would indicate that the item was a poor descriptor of the device; scores of 7 or 8 would mean that the item was a very good descriptor of the device. The intermediate degrees of fit are open to interpretation.

APPARATUS

The trainer was designed to simulate a UH-1 helicopter cockpit. It was constructed of plywood with crude instruments and controls attached. A 16mm motion picture projector, mounted on the top of the cockpit, provides the visual display. The entire cockpit is placed in front of a hemispheric screen and the subjects view filmed NOE routes which are projected onto the screen.

RESULTS

Representatives of DOAT made the decision that Stage I would be delayed. It was felt that the NOE trainer had been constructed as well as it could be and it was desirable to test it as it stood. Therefore, this report documents the results obtained after Stage II was conducted.

Forty-four instructor pilots were recruited; they reported in groups of three to act as subjects.

The metric selected for determining the rating of each essential element of analysis was the proportion of responses for each of the eight possible ratings for each item. As indicated in Table 1, several items were used, in most cases, to assess opinion concerning each of the essential elements. Therefore, the proportion of responses for any element was determined by summing the responses of each item used to assess an element and dividing by the total number of subjects responding to the items. Table 2 shows the proportion of responses for each of the rating numbers for each essential element.

Examination of the data indicated that a better interpretation of the responses would be obtained if ratings of 1, 2, and 3 were pooled and likewise ratings of 6, 7, and 8 for each element. This enlarged the "fits poorly" and "fits well" categories making for more definitive categories. Table 3 shows the results of this pooling.

Table 2

PROPORTIONS OF RESPONSES FOR ESSENTIAL ELEMENTS OF ANALYSIS

Essential Elements of Analysis	Proportions for Each Rating							
	1	2	3	4	5	6	7	8
Pilot/copilot familiarization	.51	.14	.15	.08	.04	.04	.006	.03
Navigation of course before flight	.26	.16	.14	.11	.11	.14	.07	.02
Realism to a point of near-vertigo	.26	.16	.24	.11	.03	.07	.05	.08
Relism through control panels, etc.	.66	.05	.19	.03	0.0	.03	.01	.02
Minimize actual flying hours	.24	.19	.22	.13	.05	.08	.06	.04
Terrain interpretation	.17	.14	.18	.16	.08	.18	.09	0.0
Intercrew coordination	.19	.19	.25	.17	.05	.05	.07	.03

Table 3

POOLED PROPORTIONS OF RESPONSES FOR ESSENTIAL ELEMENTS OF ANALYSIS

Essential Elements of Analysis	Pooled Porportions (Fits Poorly) 1-2-3	(Fits Well) 6-7-8
Pilot/copilot familiarization	.80	.08
Navigation of course before flight	.56	.23
Realism to a point of near-vertigo	.66	.20
Realism through control panels, etc.	.90	.06
Minimize actual flying hours	.65	.18
Terrain interpretation	.49	.17
Intercrew coordination	.63	.15

As Table 3 shows, the instructor pilots rated the device rather low on each of the essential elements. Even in those cases where the ratings had a higher spread (e.g., Terrain Interpretation and Navigation of a Course before Flight) the proportions of responses rating the device high were not impressive.

The subjects were also asked to rank each of the essential elements of analysis, estimating the importance of each element to NOE training. Table 4 shows the results of this ranking.

Table 4

RANK ORDER OF ESSENTIAL ELEMENTS ACCORDING TO ESTIMATED IMPORTANCE

Element	Rank
Pilot/copilot familiarization	2
Navigation of course before flight	3
Realism to a point of near-vertigo	7
Realism through control panels, etc.	5
Minimize actual flying hours	6
Terrain interpretation	1
Intercrew coordination	4

A coefficient of concordance was computed for the ranking, to determine the degree of agreement among the instructor pilots. The results indicated no significant agreement among the raters as to the rankings assigned above.

DISCUSSION

To supplement the data above, the instructor pilots were also asked whether any design criteria could or should be eliminated. (Such an elimination would reduce the attempted scope of coverage of the device and thus enable concentration on some essential elements to improve its suitability in these areas.) The number of responses was small and consequently the result was not conclusive. Nonetheless, six subjects suggested eliminating element 1, four suggested eliminating element 2, sixteen suggested eliminating element 3, eleven would eliminate element 4, nine would eliminate element 5, one would eliminate element 6 and one would eliminate element 7.

In addition, the instructor pilots were asked if improvements to this device were necessary. Of the forty-four subjects, forty-one (93%) responded that improvements would be necessary. Subjects were asked if these improvements would make the device acceptable if it was not currently acceptable. Twenty-nine (66%) indicated that improvements would make it acceptable, and nine (20%) indicated improvements would not make the device acceptable. Subjects were also asked if they would recommend further testing of the device. Thirty-four (77%) indicated further testing would be advisable; eight (18%) recommended no further testing.

Subjects were asked for their opinions of the device and, when applicable, for statements explaining why they rated the device 1 or 2. The subjects felt, for several reasons, that the device was ineffective but that it had some possibilities. Twenty-seven (61%) subjects stated a preference for sound, which was not present. Twenty (45%) subjects noted that the film was not realistic or of poor quality. As for the instrument panel, nineteen (43%) said it was either too dark or not present. Eighteen (41%) subjects expressed a desire to have control of the device's movement. Twenty-four (55%) subjects stated that the film gave a false judgment pattern for rotor clearance and tail boom clearance. Many stated that the importance of the side view had been neglected because it was not shown. Nineteen subjects noted that the controls were not connected. On nine occasions, terrain elevation and control were pointed out as being false. Thirteen subjects felt the device was not realistic, and eighteen suggested that the film's airspeed was too fast or that it did not show maneuvers. On balance, each of these essential elements of analysis was rated low, suggesting that the device did not appropriately accomplish the designers' purposes. Furthermore, the subjects commented on several occasions that the device was designed to accomplish a type of NOE training which was not then being taught. In other words, NOE training is not taught the way the device is designed.

CONCLUSIONS

1. Although subjects indicated, for the most part, that the device should be developed because it had some capabilities, further development of the Ft. Benning NOE trainer would not be cost beneficial considering that existing devices in use at Ft. Rucker provide effective Army aviator training.

2. This device does not have the capability, in the opinion of the pilots, to provide the map interpretation and terrain analysis essential to NOE training. A map interpretation and terrain analysis course (MITAC) is currently taught at Ft. Rucker as part of the platform instruction by the Department of Academic Training. This course was constructed and implemented after the NOE trainer was developed and the MITAC, along with other Ft. Rucker trainers, should suffice.

APPENDIX A

DEVICE DESCRIPTION INVENTORY

FT BENNING NOE TRAINER

Instructions: The Ft Benning NOE trainer is designed to provide or enhance training in six areas. This inventory is designed to elicit your opinion of the trainer's effectiveness (or estimated effectiveness) as an NOE trainer in each of the six areas. This inventory has been divided into two categories and each category has one or more statements which relate to the trainer's estimated effectiveness. You are to express your opinion as to how well the statements describe the observed or estimated performance of the trainer by placing a check mark in the appropriate box.

I. FAMILIARIZATION OF PILOT AND COPILOT WITH PROCEDURES AND TECHNIQUES OF NOE FLIGHT	Fits Poorly 1	2	Intermediate Degrees of Fit 3	4	5	6	7	Fits Well 8
1. Pilot could be easily familiarized with out of ground effect hover check	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
2. Pilot could be easily familiarized with NOE pop-up maneuver	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
3. Pilot and copilot could be easily familiarized with helicopter handling qualities at NOE altitudes	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
4. Pilot and copilot could be easily familiarized with main rotor obstacle clearance problems so as to enhance rotor clearance judgement	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
5. Pilot and copilot could be easily familiarized with tail boom clearance clearance judgement	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
6. Pilot and copilot are present sufficient information so that they could be easily familiarized with NOE emergency procedures	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
7. Pilot and copilot could be easily familiarized with NOE takeoff maneuver	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
8. Pilot and copilot could be easily familiarized with NOE deceleration/ quick-stop maneuver	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
9. Sufficient familiarization can be obtained to minimize the number of flying hours needed to learn the maneuvers above	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
10. The pilot and copilot could obtain sufficient familiarization such that they could learn to navigate a proposed course before actual flight	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

	Fits Poorly		Intermediate Degrees of Fit					Fits Well
	1	2	3	4	5	6	7	8
11. Principles of terrain analysis could be easily taught in the trainer	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
12. Principles of map interpretation could be easily taught in the trainer	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
13. As a result of training in the device, flying time to learn terrain analysis principles could be minimized	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
14. As a result of training in the device, flying time to learn map interpretation principles could be minimized	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
15. Pilot and copilot could easily learn to coordinate cockpit activities required for flying and maneuvering an aircraft at NOE	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
16. This device can provide sufficient inter-crew coordination to minimize actual flying hours	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
17. Pilot and copilot could easily learn inter-crew coordination for navigations at NOE	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
18. This device could provide sufficient inter-crew coordination training for navigating NOE to minimize actual flying hours	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
19. This device would be suitable as an NOE trainer for other active Army, Reserve and National Guard Flight Facilities	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

II. REALISM	Fits Poorly 1	2	Intermediate Degrees of Fit 3	4	5	6	7	Fits Well 8
20. This device is realistic to a point of near vertigo	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
21. The visual display is highly realistic	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
22. The instrument panels are highly realistic	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
23. Controls are highly realistic	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
24. Sound effects are highly realistic	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

III. In this space please explain any rating 1 or 2. Write the number of the statement and your reason for the rating.

IV. The designer of the Ft Benning NOE trainer designed the device to enhance training in certain areas designated below. Please complete the matrix below.

Purpose	Rank these in order of importance for NOE training (1 = most impt, etc.)	Are all of these items essential, or could some be eliminated? Which would you eliminate?	Would improvement of a characteristic improve its effectiveness? Which would you improve? How?
1. Familiarize the pilot and copilot with procedures and techniques of NOE flight			
2. Navigation of a proposed course before actual flight			
3. Realism (to a point of near vertigo)			
4. Realism through the use of control panels and sound effects			
5. Minimize actual flying hours			
6. Terrain interpretation			
7. Inter-crew coordination			

V. This device was not designed to teach the principles of navigation, map interpretation or terrain analysis. Should it do so? What other functions or purposes does this device need in order to enhance its training effectiveness for NOE?

VI.	YES	NO
1. Are improvements to this device <u>necessary</u>?	[ ]	[ ]
2. Would these improvements make it acceptable if it's not?	[ ]	[ ]
3. Would you recommend further testing of the device?	[ ]	[ ]